Creating an HPC (High-Performance Computing) cluster involves setting up multiple computers (nodes) to work together as a single cohesive system to perform computationally intensive tasks. Below is an explanation of the architecture, an example configuration, and a simple diagram.

**HPC Cluster Architecture Master Node**

An HPC cluster typically consists of the following components:

1. **Master Node (Head Node):**
   * Manages the cluster, scheduling, and resource allocation.
   * Runs job scheduling software (e.g., Slurm, PBS, Torque).
   * Stores the centralized file system (NFS).
2. **Compute Nodes:**
   * Perform the actual computations.
   * Connected to the master node via high-speed interconnects (e.g., InfiniBand, Ethernet).
3. **Shared Storage:**
   * Centralized storage accessible by all nodes (e.g., NFS, Lustre, BeeGFS).
4. **Interconnect Network:**
   * High-speed network for communication between nodes.
   * Examples: Ethernet (1/10/40/100 Gbps) or InfiniBand.
5. **Scheduler/Resource Manager:**
   * Allocates jobs to nodes and ensures efficient use of resources.

**Diagram**

Let’s create a visual description:

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| Master Node |

| - Job Scheduler (e.g., |

| SLURM, PBS, etc.) |

| - Resource Manager |

| - Shared Storage (NFS) |

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| Compute Node | | Compute Node | | Compute Node |

| (CPU/GPU) | | (CPU/GPU) | | (CPU/GPU) |

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**Example Configuration**

For a small cluster with a master node and two compute nodes:

**Master Node Setup**

1. Install essential packages:

bash

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sudo apt update

sudo apt install -y slurm-wlm nfs-kernel-server openssh-server

1. Configure NFS (shared storage):
   * Add /shared to /etc/exports:

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/shared \*(rw,sync,no\_subtree\_check)

* + Restart NFS:

bash

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sudo systemctl restart nfs-kernel-server

1. Configure SLURM:
   * Edit /etc/slurm/slurm.conf with:

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ControlMachine=master-node

NodeName=node[01-02] CPUs=4 State=UNKNOWN

PartitionName=debug Nodes=node[01-02] Default=YES MaxTime=INFINITE State=UP

1. Start SLURM:

bash

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sudo systemctl start slurmctld

**Compute Node Setup**

1. Install required packages:

bash

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sudo apt update

sudo apt install -y slurm-wlm openssh-server nfs-common

1. Mount shared storage:
   * Add to /etc/fstab:

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master-node:/shared /shared nfs defaults 0 0

* + Mount the shared directory:

bash

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sudo mount -a

1. Start SLURM daemons:

bash

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sudo systemctl start slurmd

**Testing the Cluster**

Submit a test job from the master node:

1. Create a sample job script test\_job.sh:

bash

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#!/bin/bash

#SBATCH --job-name=test\_job

#SBATCH --output=output.txt

#SBATCH --ntasks=1

#SBATCH --time=00:01:00

#SBATCH --partition=debug

echo "Hello from $(hostname)"

1. Submit the job:

bash

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sbatch test\_job.sh

1. Check the job status:

bash

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squeue

Would you like me to generate a detailed diagram image or provide further information on scaling this cluster?

